How Return and Risk Experiences Shape Investor Beliefs and Preferences

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Abstract: Combining brokerage records and matching monthly survey measurements of a sample of individual investors from the Netherlands for the period April 2008 through March 2009, we examine how individual investors update their beliefs (return expectations and risk perceptions) and preferences (risk tolerance) as a result of their personal return and risk experiences. Past returns positively impact return expectations and risk tolerance, and negatively impact risk perceptions. Realized risk, however, has no effect. That is, even in a highly volatile stock-market period in which risk appears very salient, investors do not take it into account when updating their beliefs and preferences.

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Abstract: Combining brokerage records and matching monthly survey measurements of a sample of individual investors from the Netherlands for the period April 2008 through March 2009, we examine how individual investors update their beliefs (return expectations and risk perceptions) and preferences (risk tolerance) as a result of their personal return and risk experiences. Past returns positively impact return expectations and risk tolerance, and negatively impact risk perceptions. Realized risk, however, has no effect. That is, even in a highly volatile stock-market period in which risk appears very salient, investors do not take it into account when updating their beliefs and preferences.

1. Introduction

There is an increasing interest in how behavioral factors affect financial markets (Bowman and Buchanan, 1995; Blasco, Corredor, and Ferreruela, 2012; Shu *et al.*, 2013). The majority of such research is from a corporate, investment, or market perspective (Benson, Faff, and Smith, 2014). Moreover, there is a relative scarcity of research employing alternative methodologies to quantitative, such as surveys and experiments (Benson *et al.*, 2015). Noteworthy exceptions are recent studies on the behavioral underpinnings of individual investor beliefs and preferences (Tourani-Rad and Kirkby, 2005; Harding and He, 2015; Gerrans, Faff, and Hartnett, 2015). We add to this emerging stream of literature by conducting a field study to examine how individual investors update their beliefs (i.e., return expectations and risk perceptions) and preferences (i.e., risk tolerance) in response to personal return and risk experiences. We analyze a unique combination of Dutch brokerage records and matching monthly survey measurements of return expectations, risk perceptions, and risk tolerance. It is important to understand how individual investors update their beliefs and preferences, because these are central determinants of their trading and risk-taking behavior (Hoffmann, Post, and Pennings, 2015). Individual investor behavior, in turn, can affect asset prices (Hirshleifer, 2001; Kumar and Lee, 2006; Kogan *et al.*, 2006; Barber, Odean, and Zhu, 2009; Han and Kumar, 2013), return volatility (Foucault, Sraer, and Thesmar, 2011), and the macro-economy (Korniotis and Kumar, 2011a).

Our sample period from April 2008 through March 2009 corresponds to a time of considerable stock-market volatility. Accordingly, there is substantial variation in investors' beliefs and preferences, as well as in their portfolio returns and risk, which is beneficial for examining the effect of investors' realized portfolio returns and risk on subsequent changes in their beliefs and preferences. We find that investors' past returns positively impact their return

expectations and risk tolerance, and negatively impact their risk perceptions. Thus, when updating beliefs and preferences, investors extrapolate recent return experiences. The risk of these past returns (as measured by their standard deviation), however, does not impact investors' return expectations, risk perceptions, or risk tolerance. Thus, even in a highly volatile stock-market period in which risk appears very salient, investors do not take it into account when updating their beliefs and preferences. The absence of an effect of risk relates to the complexity of standard risk measures, investor sophistication, and potentially the lower availability of risk signals. We do not find evidence that the updating process of investor beliefs and preferences is compatible with a rational benchmark. Rather, return and risk experiences influence beliefs and preferences consistent with behavioral finance predictions.

This paper builds upon earlier experimental work and extends scant field evidence on how return and risk experiences drive updates in individual investor beliefs and preferences. Prior experimental literature indicates that both return and risk experiences are important in shaping investors' beliefs and preferences. This literature, however, draws on various behavioral concepts and provides mixed evidence for the directional impact of such experiences on individual investors' beliefs and preferences. Evidence on the hot-hand fallacy, for example, suggests that investors extrapolate recent return experiences into the future (Gilovich, Vallone, and Tversky, 1985; De Bondt, 1993; Johnson, Tellis, and Macinnis, 2005), while the gambler's fallacy suggests that investors expect a reversal after good returns (Tversky and Kahneman, 1971; Kroll, Levy, and Rapoport, 1988). As another example of mixed experimental findings, De Bondt (1993) finds a positive relationship between past returns and risk perceptions, while Ganzach (2000) and Shefrin (2001) indicate a negative relationship between past returns and risk perceptions. Overall, the experimental studies do not provide a coherent perspective on how

investors update their beliefs and preferences as a result of their return and risk experiences. The mixed experimental evidence might result from the lack of a real decision context or the use of participant samples that may not actively invest. Ultimately, how investors update their beliefs and preferences thus becomes an empirical question, which field studies might be better suited to answer than experiments.

Existing field evidence, however, typically focuses on the relation between past returns and return expectations, and proxies for personal return and risk experiences through index returns and/or index volatility. Dominitz and Manski (2011), Greenwood and Shleifer (2014), and Kaplanski *et al.* (2013) find a positive relation between past index returns and expected returns in household and investor survey data. In contrast, using an event study of investor behavior around September 11, Glaser and Weber (2005) find that return forecasts are higher after a large drop in share prices, suggesting a belief in mean-reversion. Malmendier and Nagel (2011) find a positive relationship between index returns and households' willingness to take risks. Kaplanski *et al.* (2013) find in their household survey data that past index volatility is negatively related to individuals' index return expectations and positively to their index risk perceptions. Finally, Hoffmann *et al.* (2013) provide suggestive evidence for a link between index returns and individual investors' return expectations, risk perceptions, and risk tolerance, but the work of these authors leaves open the important research question of how personally experienced returns and risks drive updates in investors' beliefs and preferences.

We provide field evidence on how personal return and risk experiences shape investor beliefs (return expectations and risk perceptions) and preferences (risk tolerance). An important distinction of this paper in comparison to most previous work is that we are able to simultaneously observe direct measures of individual investors' return and risk experiences by

analyzing their brokerage records and their beliefs and preferences using a panel survey. Moreover, we examine investors' *personal* return and risk experiences instead of proxying for such experiences by index returns and/or index volatility. This is important, because investors' personal returns can deviate substantially from market returns. Finally, we test in one study the impact of both return and risk experiences on investor beliefs as well as preferences. In so doing, we provide a comprehensive set of results and a coherent view on the behavioral concepts underlying the updating process of investor beliefs and preferences.

2. Data

In the analyses of this paper, we exploit a rich dataset, which consists of a unique combination of the brokerage records of 1,376 clients of the largest discount broker in the Netherlands and matching monthly survey data from these investors from April 2008 through March 2009. Because of the richness of the dataset, it lends itself to answering a variety of research questions. Previous analyses of the dataset describe fluctuations in individual investor beliefs and preferences, as well as their behavior, during the 2008-2009 financial crisis (Hoffmann *et al.,* 2013) and show how individual investor beliefs and preferences affect trading and risk-taking behavior (Hoffmann *et al.*, 2015). In this paper, we address a new and different research question, namely how personal return and risk experiences drive updates in individual investors' beliefs and preferences. That is, while previous work on this dataset studied how individual investor beliefs and preferences fluctuate over time and drive behavior, the present paper examines what drives changes in these beliefs and preferences.

2.1 Brokerage Records

Brokerage records are available for investors who completed at least one survey during the sample period. Besides transaction information, the records contain information on investors' daily portfolio balances, demographics such as age and gender, and their six-digit postal code. Based on this postal code, which is unique to each street (or parts of a street), and data retrieved from Statistics Netherlands (Central Bureau of Statistics), we assign income and residential house value to each investor. Table 1 defines all variables. Table 2 shows descriptive statistics of all brokerage accounts available, as well as those for the subset of accounts belonging to clients who completed the survey in each month of the sample period. Table 2 indicates that about 8% of the clients of which we have survey data and/or brokerage records are male. Their average age is around 50 years and they have an annual disposable income of about €20,000 (disposable income equals gross income minus taxes, social security contributions, and health insurance premiums). Their average portfolio value at the beginning of the sample period is around €50,000. The clients are active investors: about half of them traded in each particular month of the sample period, and their annual turnover is over 100%.

[Tables 1 and 2 here]

A comparison with samples of discount brokerage clients used in other studies of investor behavior in the United States (Barber and Odean, 2000; Barber and Odean, 2002) shows that this study's sample of investors is similar in terms of age and gender, portfolio size, and turnover.[1] Moreover, according to a report on Dutch retail investors by Millward-Brown (2006), the

[1] Although this study's sample appears to be representative for active Dutch retail investors, and is similar to Barber and Odean's (2000; 2002) sample of active US retail investors, it might not be typical of Dutch households in general. In particular, compared to the general population of Dutch households, it seems likely that we oversample actively trading individual investors who might have an above-average interest in investing.

account values comprise the major share of investors' total self-managed wealth. As capital gains are not taxed in the Netherlands, tax-loss-selling plays no role in the sample.

2.2 Survey Design and Data Collection

At the end of each month between April 2008 and March 2009, a panel of the broker's clients received an email prompting them to complete an online survey. Initially, we invited 20,000 randomly selected clients to participate in our survey, of which 787 did so during the first survey wave of April 2008. The corresponding response rate of 3.9% (20,000/787 * 100% = 3.9%) is in line with those of comparable large-scale surveys (cf. Dorn and Sengmueller, 2009). Six months after the first invitation to participate in our survey, we sent a reminder email to all initially invited clients to maintain a sufficient response rate (October 2008). Hoffmann *et al.* (2013) compare the investors that responded to the survey to the broker's overall investor population and also perform an analysis of the monthly variation of non-response. Robustness checks based on these comparisons show that the sample is not subject to non-random response problems. Another possible concern is that differences in response timing might affect the results. That is, the return expectations, risk perceptions, and risk tolerance of early versus late respondents might differ, because of quickly changing market conditions. As investors' responses to the survey are clustered within the first few days after each survey email was sent, it is unlikely that there is a response-time pattern in the data that could introduce a possible bias. Indeed, in robustness checks that exclude late respondents, Hoffmann *et al.* (2013) show that response timing is unlikely to be a concern.

The survey elicited information on investors' return expectations, risk perceptions, and risk tolerance for each upcoming month (see Table 3). We use qualitative measures, as they have

greater explanatory power for individual decision-making than numerical measures (Kapteyn and Teppa, 2011). In particular, compared to numerical measures, qualitative measures better predict individual preferences among options with unknown outcomes (Windschitl and Wells, 1996), as well as actual (investment) behavior (Dohmen *et al.*, 2011).

[Table 3 here]

Return expectations, risk perceptions, and risk tolerance are measured as in Hoffmann *et al.* (2013). Return expectations reflect investors' optimism about the returns of their portfolios, risk perceptions reflect investors' interpretations of the riskiness of their portfolios, risk tolerance reflects investors' general predisposition (like or dislike) toward financial risk.

To ensure a reliable measurement instrument, we use multiple items (i.e., survey questions) per variable, include these items in the questionnaire in a random order, and use a mixture of regular- and reverse-scored items (Netemeyer, Bearden, and Sharma, 2003). After adjusting for any reverse-scored items, the final survey measures are computed by equally weighting and averaging their respective item scores. We calculate Cronbach's alphas to examine reliability (Cronbach, 1951). Cronbach's alpha indicates the degree of interrelatedness among a set of items (i.e., survey questions) that together measure a particular variable (e.g., return expectations) and is expressed as a number between 0 and 1. For a variable to be called reliable, Cronbach's alpha should be above 0.7 (Hair *et al.*, 1998). Cronbach's alpha ranges between 0.71 and 0.89 for our measures, thus indicating reliability. Appendix A1.1 contains robustness checks regarding the quality of the used survey measures.

3. Empirical Results

3.1 Main Results

We analyze how investors' return and risk experiences impact updates in their beliefs (return expectations and risk perceptions) and preferences (risk tolerance). As a baseline model specification, we run panel regressions with changes in return expectations, risk perceptions, or risk tolerance as the dependent variable. We include investors' past portfolio returns (calculated as the product of the daily relative changes in the value of their portfolio, after transaction costs and adjusting for portfolio in- and outflows) or realized portfolio risk (standard deviation of daily portfolio returns) as explanatory variables that capture their return experiences or risk experiences, respectively. With respect to investor time-invariant effects, we include gender, age, account tenure, income, average portfolio value, and house value as control variables. We include time-variant controls (Derivatives, Traded, Turnover) to capture potential effects of trading activity on the survey measures. Finally, we include month fixed effects to control for unobserved external factors (such as broad market confidence, market returns, etc.) that could impact both the survey measures and the risk and return variables. By including these controls, we can be confident about measuring the distinct effects of personal return and risk experiences on investor beliefs and preferences. Formally, we thus estimate models of the following form:

$$y_{it} - y_{it-1} = \alpha + x'_{it}\beta + \sum_{t=2}^{12} \gamma_t d_t + u_{it}, \quad (1)$$

where $y_{it} - y_{it-1}$ is the update in investor beliefs or preferences, x'_{it} includes return or risk experiences as well as other control variables, and d_t are the time dummy variables.

As an alternative to our baseline model specification, we estimate models in which the dependent variables constitute levels instead of changes in beliefs and preferences, and that include individual fixed effects. That is, we estimate models of the following form:

$$y_{it} = \alpha + x'_{it}\beta + v_i + \sum_{t=2}^{12} \gamma_t d_t + u_{it}, \quad (2)$$

where y_{it} are investor beliefs or preferences, v_i is the investor-specific intercept, x'_{it} includes return or risk experiences as well as other control variables, and d_t are the time dummy variables. Moreover, we estimate the individual fixed effects model including past returns and risk in one regression. Appendix A1.2 contains robustness checks regarding alternative time horizons for past returns and risk.

Table 4 shows that individual investors' return expectations are positively related to their personal return experiences. In the model specification without individual fixed effects (Table 4, Panel A), we document that a 1% higher experienced return in the last month translates into a .469 higher score on the return expectation scale, which ranges from 1 to 7 ($p < 0.01$). In the model specification with individual fixed effects (Table 4, Panel B), the corresponding coefficient size is .427 ($p < 0.01$). That is, investors update their return expectations according to the hot-hand fallacy and expect what they perceive as trends in returns to continue, as in Gilovich *et al.* (1985), De Bondt (1993), and Johnson *et al.* (2005). Based on the theoretical results of Rabin (2002) and Rabin and Vayanos (2010), and on interpreting Burns and Corpus's (2004) and Tyszka *et al.*'s (2008) experimental results in an investor context, updating return expectations in line with the hot-hand fallacy occurs when investors believe that returns are generated by personal investment skills. The extrapolative type of return expectations updating

that we find is thus consistent with investors using the representativeness heuristic and believing that personal investment skills drive their returns.

Investors' risk perceptions are negatively related to their return experiences (Table 4). In the model specification without individual fixed effects (Table 4, Panel A), we document that a 1% higher experienced return in the last month translates into a -.223 lower score on the risk perception scale, which ranges from 1 to 7 ($p < 0.10$). In the model specification with individual fixed effects (Table 4, Panel B), the corresponding coefficient size is -.214 ($p < 0.05$). This finding is consistent with the representativeness and the affect heuristic. That is, Shefrin (2001) argues that because of representativeness, investors expect high returns from safe stocks and low returns from risky stocks. Using their affective associations with a company when forming beliefs about returns and risk, investors assume that "good" stocks are those issued by "good" companies and associate these with both high future returns and safety.

Investors' risk tolerance is positively related to their return experiences in the model specification without individual fixed effects (Table 4, Panel A). In particular, we document that a 1% higher experienced return in the last month translates into a .186 higher score on the risk tolerance scale, which ranges from 1 to 7 ($p < 0.10$). This finding is consistent with the house-money effect of Thaler and Johnson (1990). According to this theory, individuals feel that they can afford to take more risk after experiencing an initial gain when applying a quasi-hedonic editing rule under prospect theory preferences (integrating losses with prior gains, but not with prior losses). Even if these individuals accumulate losses later on, they perceive themselves to be in the positive domain of prospect theory's value function. However, this effect is not present in the individual fixed effects model (Table 4, Panel B).

[Table 4 here]

Table 5 shows that investors' return expectations, risk perceptions, and risk tolerance are not impacted by their risk experiences. Including both past returns and risk in one regression confirms the previous results (Table 6). Taken together, the results in Tables 4-6 indicate that past returns have an extrapolative impact on return expectations, risk perceptions, and risk tolerance, while the risk of these returns plays no role. Overall, one could interpret our findings as indicating that individual investors care mainly about the returns they achieve, and not about the risk of these returns. Such an interpretation, however, contrasts prior experimental work finding that risk experiences can actually shape beliefs and preferences. This prior experimental evidence about the impact of risk experiences on investor beliefs and preferences suggests that investors' real decision context differs from a lab environment along important dimensions. Real markets, for example, might be more complex and provide investors with less information or noisier signals. If that is the case, more available signals and information that is easier to understand and/or process should be more likely to impact investors' beliefs and preferences. Likewise, more sophisticated investors should be more likely to incorporate information on realized risk than less sophisticated investors. Moreover, experiments typically use participant samples that do not actively invest. When trading with actual money in a real decision context, however, investors might behave more rationally than they do in an experiment. In Sections 3.2 – 3.5, we examine each of these possibilities.

[Tables 5-6 here]

3.2 Return and Risk Experiences: Alternative Measures

The previous findings suggest that investors care mainly about their returns, but not about the risk of these returns, as measured by their standard deviation. Such an interpretation, however, implicitly assumes that investors are able to calculate a fairly complex risk measure and find it relevant for their decisions. As this assumption might not hold for individual investors, we test several simple alternative risk measures. In addition, we test other well-known measures of risk-adjusted returns and risk.

As measures for risk-adjusted returns, we use the one-factor Alpha and the Sharpe ratio. As alternative measures for realized risk, we use the one-factor Beta, the one-factor idiosyncratic volatility, and several downside risk measures (to which the simplest risk measures belong). Prior studies using qualitative surveys or numerical experiments argue that downside risk measures might capture individual investors' interpretation of risk better than do standard symmetric measures of risk, such as the standard deviation of returns. In particular, such studies find evidence that individual investors associate risk with the semivariance of returns, the probability of a loss or a return below a target return, and the potential for a large loss (Slovic, 1967; Olsen, 1997; Unser, 2000; Veld and Veld-Merkoulova, 2008; Vlaev, Chater, and Stewart, 2009). We operationalize the latter two measures by calculating the monthly percentage of returns below a target return ("percent returns below target") and the average of the four largest negative daily returns in a given month ("average of 4 worst returns"). As the target return for calculating the semivariance (i.e., the semi-standard deviation) and the percent returns below target, we use either the return on the Dutch market index (AEX) or a return of 0%. Prior work finds these benchmarks to be the most relevant for individual investors (see e.g., Unser, 2000; Veld and Veld-Merkoulova, 2008).

With respect to the risk-adjusted return measures, we find that Alpha, like returns, is a strong driver of investor beliefs and preferences. Both variables are highly correlated (Pearson correlation coefficient is 0.72), and thus they impact investors in a similar way (see Table 7, Panel A). In particular, we find that a 1% higher experienced Alpha in the last month translates into a .410 higher score on the return expectation scale ($p < 0.01$), a -.323 lower score on the risk perception scale ($p < 0.01$), and a .234 higher score on the risk tolerance scale ($p < 0.05$), which all range from 1 to 7. The Sharpe ratio is relevant for investors' return expectations, but is not a significant predictor for their risk perceptions or risk tolerance (which is not surprising, because the Sharpe ratio combines returns with the complex measure standard deviation). In particular, a one-unit increase in last month's Sharpe ratio translates into a .205 higher score on the return expectation scale, which ranges from 1 to 7 ($p < 0.01$).

[Table 7 here]

Realized systematic risk (Beta), idiosyncratic risk, and the semi-standard deviation of returns are not significant predictors of investor beliefs and preferences (see Table 7, Panel B). Relatively simple downside risk measures, such as the percentage of returns below a target return, and the average of an investor's four worst returns, however, are significant predictors of changes in investors' return expectations: A larger percentage of returns that lie below the target return decreases investors' return expectations, while a larger average of the four worst negative returns (i.e., a less negative number) increases investors' return expectations. In particular, a 1% larger percentage of returns that lie below the index return (zero return) translates into a -.683 (-.587) lower score on the return expectation scale, which ranges from 1 to 7 ($p < 0.01$). Finally, a 1%

larger average of the four worst negative returns translates into a .135 higher score on the return expectation scale, which ranges from 1 to 7 ($p < 0.10$).

3.3 Availability of Return and Risk Signals

According to Tversky and Kahneman's (1973) availability heuristic, the extent to which individuals incorporate information depends on the ease with which it comes to mind. If our finding that investors' return expectations, risk perceptions, and risk tolerance are driven by their return experiences, but not by their risk experiences, is related to the availability of these two signals, we would expect investors who examine their portfolios more often to have a better idea about the risk they experience (i.e., they would be more likely to observe fluctuations in their portfolios, which would improve their ability to estimate the return standard deviation). We do not have access to brokerage data about investors' login frequency. Therefore, we use investors' trading activity as a proxy for the frequency with which they examine their portfolios (i.e., assuming that investors' trading activity is related to looking at their portfolios, as buying or selling a security requires investors to login to the brokerage system). We run several regressions in which we interact indicators for trading activity (having traded, indicator variables for turnover quartiles) with past returns and realized risk. These regressions do not yield significant results. This may be because trading activity is an imperfect proxy for the frequency with which investors look at their portfolios or because trading activity is typically inversely related to investment skills (see e.g., Barber and Odean, 2000; Grinblatt and Keloharju, 2009; Graham, Harvey, and Huang, 2009). That is, although investors who trade more frequently may look at their portfolios more often, they may also have inferior investment skills and be more prone to

behavioral biases, which could include a tendency to ignore relevant information, such as the risk of their portfolio's returns.

We have further data on investors' ability to observe their portfolios and their returns. Based on a survey question that asks investors to report the sign of their past portfolio return, we find that investors with returns that are close to zero have difficulty reporting the correct sign. Investors with large positive or negative returns, that are potentially more available in their minds, however, are better in reporting the correct sign of their return. Thus, availability seems to play a role in investors' ability to observe signals. Furthermore, in explaining the results on risk experiences, framing may play a role. That is, in the interface design of a typical brokerage system, only information on past returns is readily available. Investors must look up themselves information on the realized risk of each portfolio component, and to determine the risk of the complete portfolio, make relatively complex calculations. For many individual investors, this may require too much effort. Thus, they rely primarily on easily available past return information, consistent with prior work on framing and the availability heuristic (Tversky and Kahneman, 1973; Tversky and Kahneman, 1981; Kühberger, 1998).

3.4 Investor Experience and Sophistication

Experience and sophistication are key characteristics influencing investor behavior (Agnew, 2006) that could also affect the formation of investor beliefs and preferences. To examine the possible impact of these investor characteristics, we run the same regression models as before, but include interaction terms for past returns and realized risk with variables that prior literature shows to be proxies for investor experience and sophistication. In particular, we use interaction terms for derivatives trading (Bauer *et al.*, 2009; Seru, Shumway, and Stoffman, 2010), age

(Korniotis and Kumar, 2011b; Korniotis and Kumar, 2013), account tenure (Seru *et al*., 2010), income (Dhar and Zhu, 2006), and wealth, proxied by the combined value of an investor's portfolio and house (Vissing-Jorgensen, 2003; van Rooij *et al.*, 2011).

The interactions with wealth and trading derivatives, and most of the interactions with age, account tenure, and income, are not significant and not reported. For the other interactions, Tables 8 and 9 report the coefficients for the main effect and interaction term.

[Tables 8-9 here]

The overall pattern of results indicates that investors who are more experienced (longer account tenure) and more sophisticated (not in the highest age quartile, within the highest income quartile) update their return expectations, risk perceptions, and risk tolerance in a way that reflects a weaker belief in trend continuation and personal investment skills as the driver of their returns, as well as a weaker house-money effect. At the same time, sophisticated investors are also less prone to looking at past returns alone. In particular, the risk tolerance of investors in the top 50% of the income distribution is hardly impacted at all by their past returns. That is, more sophisticated investors are almost not at all subject to the house-money effect. Similar moderating patterns appear for account tenure. Consistent with Korniotis and Kumar (2011b; 2013), investors that do not belong to the highest age quartile (and thus have higher cognitive skills), have a weaker tendency to extrapolate past returns into the future (Table 8). Most importantly, realized risk matters for experienced investors: Investors with longer account tenure increase their risk perception after experiencing more risk (Table 9).

3.5 Rationality of Updates in Beliefs

Although returns are generally nearly unpredictable on a monthly basis (Welch and Goyal, 2008), while risk is predictable (Andersen *et al.*, 2001), it could be rational for investors to extrapolate past returns, but not risk, if in our sample past returns are informative for future returns (and risk), but realized risk provides no predictive power for future returns (and risk).

Investors' returns might exhibit momentum and/or investors could learn from their past returns in the sense that increased return expectations reflect that they have gained knowledge about their personal investment skills. If (one of) these explanations holds true, it would be rationally justified for these investors to expect good returns to continue. To test these possibilities, we first check whether in our sample past returns are predictive of future returns or risk. We then test whether high return expectations (potentially indicating learning about personal investment skills) predict higher future returns (in which case investors' expectations would be rationally justified). We first regress current returns on past returns. We find a positive (0.026) but insignificant coefficient (p = 0.526) for past returns. The regression of current realized risk (standard deviation) on past returns yields a negative coefficient (-0.121), which is again insignificant (p = 0.228). When we run a regression of current returns on past return expectations, the effect is also insignificant (coefficient for past return expectations is 0.003, p = 0.385). We thus conclude that for the investors in our sample, past returns do not provide information on future returns or risk that would rationally justify extrapolative expectations from past returns to future returns and risk.

As a next test on the rationality of investors' beliefs updating, we check whether in our sample past volatility predicts future volatility. When we regress current volatility on past volatility, the regression coefficient (0.755, p = 0.000) indicates that past volatility is indeed

informative for current volatility. Thus, for a rational investor, we should expect to find an effect of realized volatility on risk perceptions, which, however, is not the case.

4. Conclusion and Discussion

Using unique panel data from active individual investors, we provide field evidence of the directional impact of both return and risk experiences on investor beliefs and preferences. We find that investors' return experiences drive updates in beliefs, and to some extent also updates in preferences. That is, past returns positively impact return expectations and negatively impact risk perceptions. We also find a positive impact of past returns on risk tolerance, but only in some model specifications. The risk of these past returns, however, is not related to changes in return expectations, risk perceptions, or risk tolerance when examining standard risk measures, such as the standard deviation of returns.

The absence of an effect of realized risk is related to the complexity of standard risk measures, investor sophistication, and potentially to the lower availability of return signals compared to risk signals. When defining risk in terms of simple downside risk measures that are closely related to past returns, we do find a negative impact of risk experiences on return expectations. The tendency to look primarily at past returns is pronounced among inexperienced and unsophisticated investors. These investors might find it difficult to interpret portfolio risk, and use portfolio returns as a more easily available performance metric. We do not find evidence that this updating process is compatible with a rational benchmark. Rather, return and risk experiences influence investors' beliefs and preferences consistent with predictions from the representativeness heuristic, the affect heuristic, and the availability heuristic. Given that we examine a sample of rather active and experienced individual investors, which should be more

familiar with the notion of risk than the average Dutch household, our findings on the failure to incorporate risk experiences when updating beliefs are potentially even more pronounced in the general population.

The results of this paper help explain the stylized fact that past fund returns are positively related to fund flows, while past risk has no impact, except for sophisticated investors (Sirri and Tufano, 1998; Huang *et al.*, 2012; Chalmers *et al.*, 2013). As past returns shape return expectations, risk perceptions, and risk tolerance, and these variables drive investors' trading and risk-taking behavior, past returns drive fund flows. As standard measures of past risk are not related to changes in return expectations, risk perceptions, and risk tolerance, however, risk has no impact on fund flows. Furthermore, the extrapolative impact of past returns on subsequent changes in investor beliefs and preferences helps to explain the creation of asset-price bubbles. The experiments of Hommes *et al.* (2005; 2008) show that such bubbles occur when individuals have trend-following expectations. Our results provide field evidence for the existence of these conditions in financial markets.

As to the practical implications and relevance of our study, Bateman *et al.* (2011) note the worldwide shift towards individual pension accounts and the heavy choice burden that this move puts on individuals. For example, these authors report that Australian employees must (subject to the availability of default options) decide on investment of their mandatory retirement savings contributions, choosing from up to 2,000 managed funds. The question is whether all individuals are ready to cope with this choice burden and the according transfer of risk and responsibility of retirement saving and investment decisions from plan sponsors to individuals. The recent work by Earl *et al.* (2015), Gerrans and Yap (2014), and Gan *et al.* (2014) on the financial literacy of (Australian) pension plan participants suggest various challenges in this regard. The results of

our study add to this collection of work by suggesting that individuals likely have difficulties grasping the concept of (financial) risk, at least in the way that it is typically operationalized in finance theory and the financial industry. Butt *et al.* (2015) interviewed Australian fund executives on the implementation of *MySuper*, a regulatory framework for default retirement savings funds that providers were required to have in place by the beginning of 2014. Although these authors document an evolvement towards a better alignment of providers' purpose and motivation with perceived member interests, they also note that the standard risk measures of providers are a poor representation of how participants perceive risk, which is consistent with this study's results on individual investors' difficulty of understanding risk and including it in the updating of their beliefs.

As a potential limitation of our study, we note that our sample period is from April 2008 through March 2009. On the one hand, this is beneficial for examining the effect of investors' realized portfolio returns and risk on subsequent changes in their beliefs and preferences, as there is substantial variation in beliefs and preferences, as well as in portfolio returns and risk. On the other hand, our sample period corresponds to a relative volatile market period, and investors may update their beliefs and preferences less in more tranquil times. In particular, investors' risk perceptions may be more stable in non-crisis periods. Future research should therefore examine the generalizability of our findings across time.

Appendix A1: Robustness Checks

A1.1 Quality of the Survey Measures

As the survey measures of investor return expectations, risk perceptions, and risk tolerance are central to our analyses, it is important to validate their quality. A potential concern in this regard is that investors may not be aware of their return and risk experiences. In that case, changes in beliefs and preferences could be driven by unobserved factors instead of investors' actual return and risk experiences. We have access to an additional survey question that allows us to directly check for potential problems in this regard. Specifically, from October 2008 through March 2009, investors responded to the following statement: "This month, I made a positive return." Investors' responses to this question were recorded on a seven-point Likert scale, ranging from 1 = totally agree to 7 = totally disagree, with the scale midpoint (category 4) labeled "neutral." We recode this survey variable into a new variable indicating whether investors correctly reported the sign of their return experience: Whenever an investor agreed with the statement (categories 1 to 3) and had a positive return or disagreed with the statement (categories 5 to 7) and had a negative return, we count this as a correct identification of the sign of the realized return; otherwise, we record an incorrect identification of the return sign.

It is not obvious how category 4 ("neutral") should be treated. To be conservative, we first treat all such responses as being in the incorrect sign category. Based on this conservative classification, 72.11% percent of investors correctly identify the sign of the return they realized over the past month. As an alternative classification, we exclude from the sample the responses in the "neutral" category, as well as observations where realized returns are very close to zero (between -1 and +1 percent). That is, we exclude those returns where it is likely that investors respond correctly or incorrectly just by accident. Based on this less conservative classification,

83.85% of investors give a correct response to the survey question. Thus, over a one-month time horizon, which is the primary focus of our analysis, most investors have a good idea of their performance in terms of the sign of their past returns.

In addition, we have supporting evidence from another survey variable, where we asked investors from October 2008 through March 2009 to report their number of transactions in the last month. The difference between the self-reported and the actual number of trades is only +0.14, on average, and statistically indistinguishable from zero ($p = 0.77$).

In conclusion, responses to both the sign of the past returns question and the last month's number of trades question indicate that most investors in the sample are well aware of their recent performance and trading activity.

Another potential concern with respect to the quality of the survey measures is that they are measured on a Likert scale that ranges from 1 to 7. Thus, investors that have responses at or close to the scales' upper or lower limit in a certain month might not be able to express updates in their beliefs and preferences for the next month appropriately. Hence, to test the robustness of the results, we exclude all observations where return expectation, risk perception, or risk tolerance values are smaller than 2 or larger than 6 and estimate the models of Section 3.1 again on the resulting subsample, which includes 84% of observations in the original sample. The results are consistent with the previous findings reported in Section 3.1: Past returns impact changes in beliefs and preferences in the same way as before (similar coefficient magnitudes and levels of significance), while we do not find an effect of realized risk on changes in beliefs and preferences (detailed results available upon request).

A final concern relates to the wording of the survey questions eliciting return expectations. Although the Cronbach's alpha of the overall return expectations construct (consisting of five

items) indicates it is a reliable measure (see Section 2.2), one could claim that only the fourth item of this scale measures return expectations per se, while the other items pick up more general investor optimism. To check for this possibility, we repeat the main analysis, now including only the fourth item in the return expectations measure. The results from this specification are consistent with the previous ones: In the return expectation regression, the coefficient for past returns is 0.39 and significant ($p < 0.01$), while the coefficient for realized risk is 0.001 and insignificant ($p = 0.98$, compare Tables 4-5).

A1.2 Alternative Time Horizons

In the main analyses, we test the impact of the last month's return and risk on changes in investor beliefs and preferences, finding that past returns are an important determinant thereof but that realized risk is not. To assess the robustness of these findings, in the following, we test the effect of using different time horizons for past returns and risk. In particular, we run the same regression models as in Section 3.1, but instead of using information on the returns and risk of the past month, we use information on the past 60, 20, and 10 days. Results obtained from these alternative specifications are consistent with the findings reported in Section 3.1: Past returns are an important predictor of investors' beliefs and preferences (Table A1.1), whereas risk is not (detailed results available upon request).

Table A1.1
Impact of Past Return on Changes in Survey Measures—Alternative Past Return Windows

Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Return past 60 days	0.467	0.077 ***	-0.007	0.120	0.291	0.091 ***
Return past month (baseline)	0.469	0.086 ***	-0.223	0.133 *	0.186	0.110 *
Return past 20 days	0.460	0.080 ***	-0.296	0.122 **	0.056	0.098
Return past 10 days	0.452	0.069 ***	-0.241	0.105 **	0.063	0.082

This table presents the results from regressions of changes in investor return expectation, risk perception, or risk tolerance on past investor returns and a set of control variables. The columns show results of the same panel models previously used in Table 4 (Panel A), with alternative windows for past returns. Each line reported refers to an alternative model specification (separate regression). All returns are scaled to refer to monthly terms, except for the past 60 days regressions. Here, returns are scaled to two monthly terms and consistent with that scale, the dependent variable is the change in return expectation (or risk perception, risk tolerance) over the last two months. Variables are defined in Table 1. Standard errors are clustered on the investor level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

This analysis provides some additional insights. In particular, the coefficients for past returns become more significant in the risk-perception regression for shorter time windows, while the opposite occurs for risk tolerance. These results complement previous empirical evidence obtained with household data by Malmendier and Nagel (2011) as well as Greenwood and Shleifer (2014) that more recent experiences matter more in the formation of beliefs. Furthermore, these results extend Bateman *et al.*'s (2011) finding that investors' preferences (risk tolerance) are relatively stable, in that we find that such preferences are impacted more by long-term experiences than by short-term ones.

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Table 1
Variable Definitions

Variable	Definition
Gender	Indicator variable taking the value 0 for male investors and 1 for female investors.
Age	Age of the investor in years as of April 2008.
Account Tenure	Number of years the investor is already client of the brokerage firm as of April 2008.
Income	Annual disposable income in 2007 (equals gross income minus taxes, social security contributions, and health insurance premiums paid). Assigned to each investor based on her 6-digit postal code. This postal code is unique for each street in the Netherlands. Data source is the average net income per 6-digit postal code from Statistics Netherlands (Central Bureau of Statistics).
Portfolio Value	Value of the investment assets in an investor's account at the end of the month.
House Value	Value of the house in 2008. Assigned to each investor based on his or her 6-digit postal code. This postal code is unique for each street in the Netherlands. Data source is the average residential house value per 6-digit postal code from Statistics Netherlands (Central Bureau of Statistics).
Derivatives	Indicator variable taking the value 1 if an investor traded an option or futures contract at least once during a particular month; 0 otherwise.
Traded	Indicator variable taking the value 1 if an investor traded in a particular month; 0 otherwise.
Turnover	Average of the absolute values of all purchases and sales in a particular month, divided by the average of the portfolio values at the beginning and end of a particular month.
Return	Monthly investor return given by the product of the daily relative changes in the value of his or her portfolio, after transaction costs and adjusting for portfolio in- and outflows. For example, a monthly return of 10% takes the value 0.1 in the data.
Std(Return)	Investor-specific standard deviation of daily portfolio returns in a particular month (in monthly terms).
Alpha	One-factor alpha (Jensen's alpha) in a particular month (in monthly terms).
Beta	One-factor beta in a particular month.
Idiosyncratic Volatility	Standard deviation of the residuals in the one-factor model regression (in monthly terms).
Sharpe Ratio	Monthly return divided by the standard deviation of return (in monthly terms).
Semi-standard deviation (Index Return)	Standard deviation of daily portfolio returns below the target return in a particular month (in monthly terms). Target return is the return on the Dutch stock market index AEX.
Semi-standard deviation (Zero Return)	Standard deviation of daily portfolio returns below the target return in a particular month (in monthly terms). Target return is a return of 0%.
Percent Returns below Target (Index Return)	Monthly percentage of daily portfolio returns that are below the target return. Target return is the return on the Dutch stock market index AEX.
Percent Returns below Target (Zero Return)	Monthly percentage of daily portfolio returns that are below the target return. Target return is a return of 0%.
Average of 4 Worst Returns	Average of the four largest negative daily returns in a given month (in monthly terms).
Return Expectation	Reflects how optimistic a respondent is about his or her investment portfolio and its returns in the upcoming month. Details on the survey questions are given in Table 3.
Risk Perception	Reflects a respondent's interpretation of how risky the stock market will be in the upcoming month. Details on the survey questions are given in Table 3.
Risk Tolerance	Reflects a respondent's general predisposition toward financial risk. Details on the

survey questions are given in Table 3.

Because of data availability, the data retrieved from Statistics Netherlands refer to different years, that is, to 2007 for income and to 2008 for house value.

Table 2
Descriptive Statistics

Panel A: All Brokerage Accounts

Month		Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09
Investors	N	1,376	1,376	1,376	1,376	1,376	1,376	1,376	1,376	1,376	1,376	1,376	1,376
Gender (Fraction Female)	mean	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08	0.08
Age in Years	mean	50.56	50.56	50.56	50.56	50.56	50.56	50.56	50.56	50.56	50.56	50.56	50.56
	std	13.57	13.57	13.57	13.57	13.57	13.57	13.57	13.57	13.57	13.57	13.57	13.57
Account Tenure	mean	4.07	4.07	4.07	4.07	4.07	4.07	4.07	4.07	4.07	4.07	4.07	4.07
	std	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77	2.77
Income €	mean	20,242	20,242	20,242	20,242	20,242	20,242	20,242	20,242	20,242	20,242	20,242	20,242
	std	4,314	4,314	4,314	4,314	4,314	4,314	4,314	4,314	4,314	4,314	4,314	4,314
Portfolio Value €	mean	52,854	52,695	44,872	42,840	45,963	37,688	31,127	30,100	30,679	29,564	26,514	27,875
	std	156,058	156,096	134,883	127,338	135,203	117,935	101,325	104,663	105,279	99,322	91,598	92,307
House Value €	mean	278,982	278,982	278,982	278,982	278,982	278,982	278,982	278,982	278,982	278,982	278,982	278,982
	std	112,278	112,278	112,278	112,278	112,278	112,278	112,278	112,278	112,278	112,278	112,278	112,278
Derivatives	mean	0.22	0.20	0.21	0.21	0.19	0.22	0.25	0.18	0.16	0.17	0.17	0.18
Traded	mean	0.46	0.47	0.48	0.47	0.41	0.51	0.63	0.42	0.37	0.41	0.40	0.42
Turnover (Traders)	mean	0.55	0.46	0.42	0.60	0.46	0.62	0.99	0.73	0.61	0.80	0.67	0.78
	std	1.53	1.22	1.12	1.85	1.41	1.87	3.63	1.82	1.82	2.77	2.49	2.46
Return	mean	0.03	0.00	-0.17	-0.10	0.05	-0.24	-0.23	-0.12	-0.04	0.00	-0.16	-0.01
	std	0.16	0.13	0.19	0.19	0.17	0.19	0.33	0.19	0.20	0.19	0.18	0.19
Std(Return)	mean	0.14	0.13	0.18	0.23	0.18	0.31	0.53	0.36	0.26	0.27	0.23	0.30
	std	0.25	0.23	0.29	0.33	0.28	0.36	0.42	0.37	0.32	0.32	0.32	0.35

Table 2
Descriptive Statistics – continued

Panel B: Survey Respondents													
Month		Apr-08	May-08	Jun-08	Jul-08	Aug-08	Sep-08	Oct-08	Nov-08	Dec-08	Jan-09	Feb-09	Mar-09
Investors	N	787	701	605	557	520	491	650	402	330	312	272	291
Investors resp. first time	N	787	68	11	10	2	4	494	0	0	0	0	0
Gender (Fraction Female)	mean	0.07	0.08	0.08	0.08	0.08	0.08	0.09	0.08	0.08	0.08	0.09	0.09
Age in Years	mean	50.55	51.22	51.50	51.83	52.79	52.60	51.50	52.31	52.65	52.64	53.83	53.25
	std	13.51	13.55	13.43	13.57	12.90	13.05	13.29	13.25	12.88	12.86	12.62	12.67
Account Tenure	mean	3.93	3.98	4.09	3.98	4.11	4.08	4.26	4.35	4.34	4.45	4.53	4.38
	std	2.76	2.79	2.77	2.78	2.77	2.76	2.78	2.73	2.75	2.74	2.68	2.71
Income €	mean	20,181	20,088	20,109	19,978	20,085	20,002	20,147	19,892	19,859	20,046	20,034	20,028
	std	4,285	3,956	4,240	3,729	3,835	4,153	4,197	3,808	3,543	3,897	3,844	3,860
Portfolio Value €	mean	54,446	54,264	45,411	45,509	49,557	39,707	29,490	33,660	30,169	30,693	27,444	27,229
	std	143,872	144,617	128,455	128,159	124,176	105,507	100,216	118,529	66,600	66,198	53,089	55,039
House Value €	mean	276,690	272,969	272,038	273,559	274,221	274,736	277,543	272,429	272,020	273,443	277,193	273,037
	std	110,125	102,015	109,290	101,943	101,006	110,771	112,864	104,787	98,530	99,506	108,672	100,576
Derivatives	mean	0.24	0.23	0.25	0.25	0.23	0.24	0.26	0.19	0.20	0.24	0.22	0.20
Traded	mean	0.52	0.54	0.55	0.52	0.46	0.54	0.64	0.46	0.42	0.48	0.49	0.45
Turnover (Traders)	mean	0.65	0.43	0.49	0.57	0.36	0.50	1.10	0.86	0.47	0.56	0.70	1.00
	std	1.82	1.13	1.41	1.61	0.91	1.08	4.68	2.23	1.51	1.07	2.08	3.91
Return	mean	0.03	0.00	-0.18	-0.10	0.05	-0.25	-0.22	-0.12	-0.04	0.00	-0.17	-0.01
	std	0.17	0.12	0.18	0.18	0.20	0.18	0.34	0.19	0.16	0.20	0.20	0.21
Std(Return)	mean	0.15	0.13	0.18	0.23	0.18	0.31	0.53	0.37	0.26	0.28	0.25	0.32
	std	0.29	0.22	0.29	0.34	0.30	0.38	0.43	0.39	0.32	0.31	0.38	0.43
Return Expectation	mean	4.28	4.18	3.57	3.78	4.09	3.45	3.37	3.59	3.72	3.97	3.53	4.16
	std	0.94	0.92	0.96	0.97	1.00	1.06	1.04	1.10	0.99	1.09	1.17	1.06
Risk Perception	mean	4.49	4.44	5.00	4.15	3.97	4.45	4.27	4.26	4.24	4.18	4.44	4.24
	std	1.63	1.58	1.93	1.13	1.15	1.17	1.31	1.28	1.24	1.22	1.32	1.20
Risk Tolerance	mean	3.91	3.93	3.58	3.77	3.85	3.56	3.67	3.70	3.79	3.74	3.73	3.86
	std	1.19	1.11	1.25	1.19	1.18	1.30	1.33	1.26	1.18	1.20	1.28	1.14

This table presents monthly summary statistics for the brokerage account data. Panel A refers to all investors for whom brokerage records are available. This sample includes investors who participated at least once in the survey during the sample period, and who were not excluded by the sample-selection restrictions defined in Section 2. The monthly summary statistics presented in Panel B refer to the subset of investors who responded to the survey in each respective month. "Investors resp. first time" indicates for each month the number of investors for whom this was their first participation in the survey. All other variables are defined in Table 1.

Table 3
Survey Questions

Survey Variable	Answer Categories
Return Expectation (1 = low/pessimistic, 7 = high/optimistic)	
Next month, I expect my investments to do less well than desired.	1 (totally agree)–7 (totally disagree)
For the next month, I have a positive feeling about my financial future.*	1 (totally agree)–7 (totally disagree)
Next month, my investments will have a worse performance than those of most other investors.	1 (totally agree)–7 (totally disagree)
Next month, it is unlikely that my investment behavior will lead to positive returns.	1 (totally agree)–7 (totally disagree)
For the next month, the future of my investment portfolio looks good.*	1 (totally agree)–7 (totally disagree)
Risk Perception (1 = low perceived risk, 7 = high perceived risk)	
I consider investing to be very risky next month.*	1 (totally agree)–7 (totally disagree)
I consider investing to be safe next month.	1 (totally agree)–7 (totally disagree)
I consider investing to be dangerous next month.*	1 (totally agree)–7 (totally disagree)
I consider investing to have little risk next month.	1 (totally agree)–7 (totally disagree)
Risk Tolerance (1 = low risk tolerance, 7 = high risk tolerance)	
Next month, I prefer certainty over uncertainty when investing.	1 (totally agree)–7 (totally disagree)
Next month, I avoid risks when investing.	1 (totally agree)–7 (totally disagree)
Next month, I do not like to take financial risks.	1 (totally agree)–7 (totally disagree)
Next month, I do not like to "play it safe" when investing.*	1 (totally agree)–7 (totally disagree)

This table presents the questions used in this study's 12 monthly surveys. A 7-point Likert scale is used to record investors' response to each question. Each survey variable (return expectation, risk perception, risk tolerance) is calculated as the equally weighted average of the respective survey questions. * denotes a reverse-scored question.

Table 4

Impact of Past Return on Survey Measures

Panel A						
Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Return	0.469	0.086 ***	-0.223	0.133 *	0.186	0.110 *
Gender	0.053	0.039	-0.027	0.055	-0.015	0.041
Age	0.001	0.001	-0.001	0.001	-0.001	0.001
Account Tenure	-0.002	0.003	-0.002	0.005	0.003	0.004
ln(Income)	0.014	0.088	0.095	0.161	-0.116	0.105
ln(Avg. Portfolio Value)	-0.003	0.006	0.002	0.009	-0.006	0.007
ln(House Value)	0.016	0.045	-0.040	0.074	-0.004	0.051
Derivatives	0.017	0.041	-0.074	0.072	-0.050	0.050
Traded	0.038	0.031	0.034	0.053	0.119	0.038 ***
Turnover	0.029	0.012 **	-0.041	0.017 **	0.029	0.020
Constant	0.144	0.586	-0.633	1.049	1.214	0.676 *
Time fixed effects	YES		YES		YES	
N Observations	3,955		3,955		3,955	
N Investors	1,045		1,045		1,045	
R^2	0.165		0.063		0.032	

Panel B						
Dependent Variable	Return Expectation		Risk Perception		Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Return	0.427	0.079 ***	-0.214	0.107 **	0.043	0.073
Derivatives	0.076	0.053	-0.094	0.090	0.029	0.057
Traded	0.114	0.031 ***	-0.043	0.052	0.201	0.036 ***
Turnover	0.030	0.012 **	-0.009	0.014	0.022	0.013 *
Constant	3.595	0.069 ***	4.503	0.103 ***	3.567	0.070 ***
Individual fixed effects	YES		YES		YES	
Time fixed effects	YES		YES		YES	
N Observations	5,918		5,918		5,918	
N Investors	1,376		1,376		1,376	
Overall R^2	0.103		0.031		0.021	

Panel A of this table presents the results from regressions of changes in investor return expectation, risk perception, or risk tolerance on past investor returns and a set of control variables. That is, we regress the monthly update of beliefs and preferences on the respective return experience in that month. The columns show results of linear panel models. The number of individual investors included in the regression (1,045) is smaller than the sample available for analysis (1,376) because not all investors responded to the survey for two consecutive months. Panel B presents the results from regressions of levels of investor return expectation, risk perception, or risk tolerance on past investor returns and a set of control variables. That is, we regress the end of the month level of beliefs and preferences on the respective return experience in that month. The columns show results of linear panel models with individual fixed effects. In all models, standard errors are clustered on the investor level. Variables are defined in Table 1. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 5
Impact of Past Risk on Survey Measures

Panel A						
Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Std(Return)	-0.013	0.043	0.033	0.072	-0.001	0.054
Gender	0.055	0.038	-0.027	0.055	-0.014	0.041
Age	0.000	0.001	-0.001	0.001	-0.001	0.001
Account Tenure	-0.002	0.003	-0.003	0.005	0.003	0.004
ln(Income)	0.014	0.088	0.094	0.161	-0.116	0.105
ln(Avg. Portfolio Value)	0.004	0.006	0.000	0.009	-0.003	0.007
ln(House Value)	0.021	0.045	-0.043	0.074	-0.002	0.051
Derivatives	-0.017	0.041	-0.062	0.075	-0.064	0.051
Traded	0.031	0.031	0.036	0.053	0.116	0.038 ***
Turnover	0.017	0.012	-0.037	0.016 **	0.024	0.020
Constant	-0.816	0.591	-0.217	1.043	0.989	0.685
Time fixed effects	YES		YES		YES	
N Observations	3,955		3,955		3,955	
N Investors	1,045		1,045		1,045	
R^2	0.158		0.063		0.031	

Panel B						
Dependent Variable	Return Expectation		Risk Perception		Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Std(Return)	-0.081	0.079	0.127	0.112	-0.031	0.065
Derivatives	0.068	0.053	-0.090	0.090	0.028	0.057
Traded	0.110	0.032 ***	-0.041	0.052	0.201	0.036 ***
Turnover	0.027	0.013 **	-0.009	0.014	0.022	0.013 *
Constant	3.542	0.070 ***	4.508	0.104 ***	3.567	0.071 ***
Individual fixed effects	YES		YES		YES	
Time fixed effects	YES		YES		YES	
N Observations	5,918		5,918		5,918	
N Investors	1,376		1,376		1,376	
Overall R^2	0.098		0.031		0.021	

Panel A of this table presents the results from regressions of changes in investor return expectation, risk perception, or risk tolerance on the realized risk of investor returns (standard deviation of return) and a set of control variables. That is, we regress the monthly update of beliefs and preferences on the respective risk experience in that month. The columns show results of linear panel models. The number of individual investors included in the regression (1,045) is smaller than the sample available for analysis (1,376) because not all investors responded to the survey for two consecutive months. Panel B presents the results from regressions of levels of investor return expectation, risk perception, or risk tolerance on the realized risk of investor returns (standard deviation of return) and a set of control variables. That is, we regress the end of the month level of beliefs and preferences on the respective risk experience in that month. The columns show results of linear panel models with individual fixed effects. In all models, standard errors are clustered on the investor level. Variables are defined in Table 1. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 6

Impact of Past Return and Risk on Survey Measures

Dependent Variable	Return Expectation			Risk Perception			Risk Tolerance		
	Coef.	Std. err.		Coef.	Std. err.		Coef.	Std. err.	
Return	0.433	0.077	***	-0.188	0.110	*	0.036	0.077	
Std(Return)	0.018	0.076		0.084	0.115		-0.023	0.069	
Derivatives	0.076	0.053		-0.094	0.090		0.029	0.057	
Traded	0.114	0.031	***	-0.043	0.052		0.201	0.036	***
Turnover	0.029	0.012	**	-0.010	0.014		0.022	0.013	*
Constant	3.592	0.070	***	4.487	0.105	***	3.571	0.072	***
Individual fixed effects	YES			YES			YES		
Time fixed effects	YES			YES			YES		
N Observations	5,918			5,918			5,918		
N Investors	1,376			1,376			1,376		
Overall R^2	0.104			0.032			0.021		

This table presents the results from regressions of levels of investor return expectation, risk perception, or risk tolerance on past investor returns, realized risk of investor returns (standard deviation of return), and a set of control variables. That is, we regress the end of the month level of beliefs and preferences on the respective return and risk experience in that month. The columns show results of linear panel models with individual fixed effects. Standard errors in all models are clustered on the investor level. Variables are defined in Table 1. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 7

Impact of Past Return and Risk on Changes in Survey Measures—Alternative Return and Risk Measures

Panel A: Impact of Past Performance

Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Alpha	0.410	0.086 ***	-0.323	0.112 ***	0.234	0.101 **
Sharpe Ratio	0.205	0.028 ***	-0.062	0.047	0.029	0.037

Panel B: Impact of Realized Risk

Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Beta	-0.002	0.016	-0.030	0.029	-0.010	0.020
Idiosyncratic Volatility	0.009	0.059	0.059	0.094	0.004	0.073
Semi-Standard Deviation (Index Return)	-0.039	0.039	0.057	0.069	-0.072	0.061
Semi-Standard Deviation (Zero Return)	-0.045	0.042	0.041	0.068	-0.059	0.056
Percent Returns below Target (Index Return)	-0.683	0.142 ***	0.264	0.249	-0.034	0.188
Percent Returns below Target (Zero Return)	-0.587	0.168 ***	0.066	0.279	0.196	0.218
Average of 4 Worst Returns	0.135	0.081 *	0.037	0.152	0.029	0.107

This table presents the results from regressions of changes in investor return expectation, risk perception, or risk tolerance on alternative past investor return measures (Alpha, Sharpe ratio; Panel A), and alternative realized risk measures (Beta, idiosyncratic volatility, semi-standard deviation, percent returns below target, average of four worst returns; Panel B) and a set of control variables. That is, we regress the monthly update of beliefs and preferences on the respective return and risk experiences in that month. The columns show results of the same panel models previously used in Table 4 (Panel A), with alternative measures for past returns and risk. Each line reported refers to an alternative model specification (separate regression). All returns and risk variables are scaled to refer to monthly terms. Variables are defined in Table 1. Standard errors are clustered on the investor level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 8

Impact of Past Return on Changes in Survey Measures—Interactions with Investor Characteristics

Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Return	0.413	0.093 ***	-0.190	0.146	0.140	0.117
Age > 75% * Return	0.258	0.154 *	-0.142	0.241	0.202	0.215
Return	0.435	0.088 ***	-0.159	0.143	0.351	0.111 ***
Account Tenure > 75% * Return	0.117	0.174	-0.214	0.245	-0.576	0.213 ***
Return	0.406	0.095 ***	-0.225	0.153	0.316	0.126 **
Income > 50% * Return	0.136	0.147	0.006	0.222	-0.278	0.162 *

This table presents the results from regressions of changes in investor return expectation, risk perception, or risk tolerance on past investor returns and a set of control variables. That is, we regress the monthly update of beliefs and preferences on the respective return experience in that month. The columns show results of the same panel models previously used in Table 4 (Panel A), while also including alternative interaction terms. In each regression model, only one interaction term (and the main effect of the respective indicator variables) is included at the same time. That is, each two-variable block reported refers to an alternative model specification (separate regression). Reported are the main effect of the respective return variable and the interaction effect. Interaction variables with percentages refer to the quartiles in the distribution of the respective variable in the investor sample. Other variables are defined in Table 1. Standard errors are clustered on the investor level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.

Table 9

Impact of Past Risk on Changes in Survey Measures—Interactions with Investor Characteristics

Dependent Variable	Δ Return Expectation		Δ Risk Perception		Δ Risk Tolerance	
	Coef.	Std. err.	Coef.	Std. err.	Coef.	Std. err.
Std(Return)	-0.005	0.044	0.023	0.078	0.022	0.055
Age > 75% * Std(Return)	-0.039	0.095	0.039	0.136	-0.105	0.113
Std(Return)	-0.007	0.052	-0.030	0.082	-0.034	0.062
Account Tenure > 75% * Std(Return)	-0.015	0.071	0.159	0.096 *	0.087	0.088
Std(Return)	-0.035	0.054	0.057	0.098	-0.024	0.062
Income > 50% * Std(Return)	0.044	0.070	-0.049	0.112	0.045	0.083

This table presents the results from regressions of changes in investor return expectation, risk perception, or risk tolerance on the realized risk of investor returns (standard deviation of returns) and a set of control variables. That is, we regress the monthly update of beliefs and preferences on the respective risk experience in that month. The columns show results of the same panel models previously used in Table 5 (Panel A), while also including alternative interaction terms (and the main effect of the respective indicator variables). In each regression model, only one interaction term is included at the same time. That is, each two-variable block reported refers to an alternative model specification (separate regression). Reported are the main effect of the respective return risk variable and the interaction effect. Interaction variables with percentages refer to the quartiles in the distribution of the respective variable in the investor sample. Other variables are defined in Table 1. Standard errors are clustered on the investor level. *, **, and *** denote statistical significance at the 10%, 5%, and 1% levels, respectively.